OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

Ottawa Hull K1A 0C9

(21) (A1) 2,164,346
(22) 1995/12/04
(43) 1997/06/05

(51) Int.Cl.[6] E06B 3/263

(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Sealed Window Systems and Method for Constructing Same

(72) Lautenschlaeger, Friedrich Karl Wolfgang - Canada ;

(71) Same as inventor

(57) 31 Claims

Notice: This application is as filed and may therefore contain an incomplete specification.

2164346

Sealed Window Systems and Methods of Constructing Same

Abstract of the Disclosure

A sealed window system of at least two transparent plates in which these plates are separated by rigid spacers which are connected to the window frame. The spacer is designed to hold a third transparent plate. The sealed system can be disassembled, and the interior of the sealed system is accessible through sealed ports. This spacer-frame is assembled from interlocking elongate frame members that extend alongside each other and are detachably and rigidly connected to each other. The desiccant material is located in elongate pockets in that spacer-frame in such a way to desiccate more than one air space, and it can be an non-adhesive gasket, or can be part of a sealing strip comprised of adjacent desiccating and moisture sealing materials.

Background of the Invention

The present invention relates to insulated sealed building elements, and more particularly building elements of transparent materials, such as windows, doors and the like.

It is well known that insulated window units comprise two or more transparent plates which are separated by spacers. These spacers may inclose, or be surrounded by, a desiccant material which dries the air space between these plates. The spacers are held between the transparent plates by a sealant to prevent moisture penetration into the sealed unit. Various configurations of spacer and sealant assemblies are known to make up such sealed units. In a typical window construction, these sealed units are placed into the glazing pocket of the window frame and held in place by a pressure plate or glazing stop. Between the pressure plate and the sealed unit is located a protective sealant to reduce the access of moisture to the seal of the sealed unit and to increase the mechanical stability of the window assembly.

Francis (Canad. Patent 1,265,705 and U.S. Patent 4,500,572) teaches glazing with integral frame and spacer, without exterior stop for holding the outer plates in place, but without that spacer projecting outwardly with respect to the planes of the sealed unit, in a direction away from the transparent plates. Such a design requires metallic frame and spacer materials since the heavy sealed glass units are directly mounted on the building face. Such a design has the further disadvantage that the stresses of thermal expansion and contraction of the interconnected metallic support members of several adjacent windows are transmitted to the spacer between the transparent plates and to the adhesive elements that hold the sealed units together. This will lead to stresses between the metal and the glass as the result of temperature variations. Furthermore, the metallic components in the Francis design increase the heat transfer across the sealed unit more than in conventional systems. My invention is directed to improving such a design to make it more suitable for a wider range of applications and to simplify the construction of sealed units with more than two transparent plates.

Marzouki et al. (US Patent 4,411,115) teaches a sealed unit comprising three transparent plates of which the third is inserted into a rigid spacer bar. The metallic spacer bar is a tubing of a closed figure profile, with perforations to permit the desiccant inside the spacer to dry the cavity between the plates. Such closed-figure design of a metallic material has several disadvantages, such as high total material requirement, high thermal conductivity, and the requirement for a row of perforations along the metal tubing between each two transparent plates.

Sealed insulated window systems have several other limitations. For example, the processes for the production and installation of sealed units involve a large number of production steps, particularly for units which comprise more than two transparent plates. Assembling the sealed units requires high temperature, which increases the complexity of the manufacturing processes and the processing cost. A further disadvantage is that the components of sealed units cannot be re-used after failure or breakage. Also, sealed units and window frames are generally assembled in different locations. This requires the shipping of the unprotected sealed units to the window manufacturer, and limits the automation of the complete window production process.

Traditional designs for sealed insulated windows require strong fastening methods such as structural sealants and pressure plates to hold the sealed units to the building structures. Some conventional systems have limited dimensional stability when the spacer assembly consists of a deformable mastic material. This can lead to inconsistent thicknesses around the circumference of the sealed unit, and increases the probability for water ingress between the sealed unit and the external sealant. My invention prevents this by the increased rigidity of the spacer.

In insulated window systems, where the distance between the parallel transparent plates is large, the quantities of the insulating sealants required are also large. In some systems, where the sealant contains molecular sieve as a desiccating agent, that sieve reduces the pressure inside the unit as that desiccant partially absorbs the air in that unit, and the seal can be drawn further into the interior of the sealed unit.

There are several other disadvantages with conventional sealed window systems, such as the difficulty to replace the gas or the desiccating agent inside the sealed unit, and the need for special safety provisions to avoid the removal of the whole sealed unit during forced-entry attempts into a building through its windows.

I have found that these disadvantages may be overcome by the use of a rigid spacer elements that extend beyond the outer edge of the transparent plates, by detachable elongate matching frame members with openings for gas exchange, and a composite sealing and desiccating strip comprising non-adhesive and adhesive sealing sections.

Objects of the Invention

It is an object of the present invention to provide a sealed window system in which the rigid spacer means between the transparent plates are rigidly and directly connected to the window frame and further extend outwardly beyond the exterior surfaces of the transparent plates.

It is a further object of this invention to provide a sealed window system comprising elongate frame and spacer members for sealed insulated units that extend alongside each other and are rigidly and detachably connected to each other.

It is a further object of this invention to provide sealed units comprising more than two transparent plates of which the central plate is held by taps on the spacer, and the desiccating means is centrally positioned in such a way that it is in gaseous contact through those gaps with the cavities between the transparent plates .

It is a further object of this invention to provide a sealed window system comprising more than two transparent plates in which the elongate spacing members, each with a base section, extend substantially from one outer transparent plate to the other.

It is a further object of the present invention to provide a desiccating and moisture sealing strip which comprises longitudinally extending adjacent sections with one section comprising a desiccant and the other section a moisture vapor sealant.

Brief Description of the Drawings

Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings. In the drawings,

FIG. 1 is a view from the outside or the inside of a building of the sealed unit constructed in accordance with the invention;

FIG. 2, FIG. 3, FIG. 4, FIG. 5, FIG. 6, FIG. 7, FIG. 8, FIG. 9, FIG. 10, FIG. 11, FIG. 12, FIG. 13, FIG. 14, and FIG. 15 are sectional details taken along the line I - I of FIG. 1, and show embodiments of the invention;

In FIG. 2, a rigid spacer that is attached to a frame, separates the two transparent plates of a sealed unit is covered with a moisture barrier and a desiccating strip;

In FIG. 3, the rigid spacer in which the desiccant is located is of a channel-type configuration;

FIG. 4 is a sectional view similar to the embodiment in FIG. 3 except for the modification that the channel is provided with tabs to retain the desiccant material;

In FIG. 5, the rigid spacer is extended by a second and semi-rigid spacer material between the transparent plates into the interior of the sealed unit;

FIG. 6 shows the desiccant material as a resilient compressible material located in elongate grooves along the rigid spacer;

FIG. 7 shows a cavity in the spacer frame to retain the desiccant and shows a sealed vent opening from the interior of the sealed unit through the frame to the exterior;

FIG. 8 shows the spacer as an adhesive material which is inserted into an elongate recess in the frame and between the transparent plates;

FIG. 9 shows a frame with three transparent plates and a sufficiently wide sealant strip laid across the spacer frame, surrounding the periphery of a center transparent plate, and also surrounding the edges of two outer plates to provide an outer seal for the unit;

FIG. 10 shows a spacer frame cross-section which comprises an elongate groove on the exterior of the spacer and of the sealed unit, for the attachment of that frame to a support structure in the opening of a building;

FIG. 11 is an assembly of two matching elongate frame sections, spaced apart by a rigid element and by the desiccating and moisture barrier sealant strip, whereby the spacing is controlled by adjustable threaded connections through the frame and the spacer members;

FIG. 12 shows a tubular spacer with opposing taps and a rib-shaped outside extension inserted between two detachable elongate matching frame members;

FIG. 13 is similar to FIG. 12 except for the enclosure of a third transparent plate in the gap between the taps of the spacer ;

FIG. 14 shows a T-shaped spacer element for a sealed unit comprising three transparent plates of which the central plate is held in the gap of the spacer;

FIG. 15 shows the same configuration as FIG. 14 except that the spacer frame comprises elongate matching sections connected to each other by tongue and groove;

FIG. 16 shows a sealant strip, comprising adjacent desiccating and a moisture barrier functions, as it is preferably used in several of the embodiments of my invention;

FIG. 17 shows a sealing strip which comprises a center desiccating width between two adjacent moisture sealing widths;

FIG. 18 shows a sealing strip which comprises a center moisture sealing width between two adjacent desiccating widths;

FIG. 19 shows a sealing strip similar to FIG. 18 in which the center moisture sealing width is extended on one long side of that strip over the two adjacent outer desiccating widths;

FIG. 20 shows a desiccating strip similar to FIG. 17 in which the outer moisture sealing widths are extended and connected with each other over the center desiccating section on one long side of the strip ;

FIG. 21 is similar to FIG. 16 but the moisture sealing section is extended on one side of the strip over the adjacent desiccating width of the strip;

In FIG. 22 the sealant strip is shown with a moisture barrier means between the adjacent desiccating and moisture sealing widths of the strip;

FIG. 23 shows a sealed system comprising three transparent plates, sealed with the

strip shown in Fig. 23 , comprising a moisture sealing and a desiccating portion with a moisture barrier means between both portions;

FIG. 24 shows the sealant strip of Fig. 17, as it partially surrounds an open-figure tubular spacer that is positioned between the two outer transparent plates of a sealed, triple-glazed unit, whereby the center plate is held in that open configuration of that spacer channel; and

FIG. 25 shows an open figure channel as in Fig. 24, comprising two matching elongate sections connectable by tongue and groove and provided with taps, suitable to hold the center transparent plate of a sealed window system.

Description of the Preferred Embodiments

FIG. 1 is a view of the sealed unit from the outside or the inside of a building constructed in accordance with the invention. The following Figures show embodiments of my invention.

One embodiment of the invention is shown in **FIG. 2** which comprises the frame segment **1** which projects outwardly beyond the edges of the transparent plates, and from which the rectangular spacer **2** is vertically extended towards the inside of the unit. The spacer **2** and a moisture sealing material **6** on the two opposite sides of this spacer, space apart the parallel transparent plates **5**. The width of the spacer **2** is selected to achieve the desirable spacing between the transparent plates. The spacer **2** can be an integral part of the window frame, as part of the frame profile, or can be fastened to the frame **1**, and comprise any material of sufficient low compressibility to provide the spacing function The frame and spacer profile comprising the segments **1** and **2** can be produced by fastening the spacer element **2** to the profile of the frame section **1** by fastening means **10** which can be loosened from the outside of the sealed unit. The spacer **2** can comprise the same material as the frame **1**, or it can be of a different material. The frame **1** and the spacer **2** can comprise one or more of the following materials: metal, plastic, preferably PVC, or a flexible mastic material of sufficient compression resistance, with or without an additional rigid material imbedded in that spacer. The frame **1** can also comprise rigid cellular materials, honeycomb structures, and enclose channels or cavities. To the spacer **2** is attached a sealant strip which runs along the wall which faces the cavity **8** of the sealed unit and along the lateral walls between the inside of the transparent plate and that spacer. Said sealant strip comprising adjacent members **6** and **7**, in which the outer sections **6** are moisture sealing, and the center section **7** is desiccating. When the composition of **6** and **7** is identical, such a sealant strip is required to be both desiccating and vapor sealing. The material of sections **6** can be chosen to be non-tacky or of low-tack and may be applied as strip or gasket, and be easily removable. These gaskets can be placed in grooves along the spacer bar **2** as shown in a later embodiment of this disclosure. The outside periphery of the

transparent plates is covered by the glazing stop **3** which presses the transparent plates **5** against the spacer. The moisture sealing of the unit can be achieved by one or more of the following options. The sealant material **4** is placed around the edges of the transparent plates **5** and between the glazing stop and the frame section **1**. This seal is a gunnable material placed along the edge of the glass before the pressure plate is added, or a pre-shaped mastic such as a glazing tape. A seal can be placed between the spacer **2** and the transparent plates **5**, a gunnable sealing material can be placed around the edge of the transparent plate before the glazing stop **3** is added, or the stop **3** can have a moisture barrier applied to the side which faces the outer periphery of the transparent plate If these moisture sealing materials have low strength, then the window can be easily disassembled. Other known sealing methods can be applied. The shape of the glazing stop **3** and its fastening to the frame is not critical, provided a good seal that prevents the ingress of moisture vapor is achieved. To accommodate thermal movements, the gap between the edge of the transparent plate and the frame must be appropriately wide. The sealed unit can be fastened to an external frame by traditional methods through the holes **9** which pass through the pressure plate and continue in the frame element **1**. The fastening means **9** such as screws, clips or screws, hold together the glazing stop **3** and the frame member **1** and attach the window and frame unit to an outer frame **111**. The outer frame **111** is constructed of any suitable building material that can hold a window in a structural opening. This embodiment permits the removal and replacement of the desiccant. My sealed system is distinguished from known systems in the art in that the frame means extend beyond both exterior surfaces of the unit, and further that there are rigid stop means adjacent said exterior surfaces and fastened to the frame.

To fabricate rectangular units, the ends of the frame and spacer segments **1** and **2** where vertical and horizontal frame section of rectangular units are connected, can be miter-cut and connected with sealants and sleeves, or the frame can comprise more than one matching elongate sections, as described in a later embodiment of this disclosure.

A further embodiment of the invention is shown in **FIG. 3.** Its configuration is the

same as **FIG. 2** except that the spacer comprises a U-shaped channel of a rigid material comprising two extensions **20** from the frame member **24**, parallel to the direction of the transparent plates and between said transparent plates, creating the cavity **36** with the frame section **24** as the base. The desiccating material **17** is positioned within that cavity. The desiccating material **17** is a preformed formulation or a gunnable mastic.

In **FIG. 4** the configuration of the spacer channel described in **FIG. 3** is modified by providing a tab **22** at a right angle on the opposing sides of the parallel and towards the inside of the unit directed extensions **21** of the spacer, whereby said tabs create a gap **26**. This gap is sufficiently wide for the desiccating material to be effective in removing moisture from the cavity **8** between the transparent plates, and may be sufficiently wide to frictionally hold a third transparent plate parallel to the outer transparent plates.

The embodiment of my invention in **FIG. 5** represents a modification of the embodiment in **FIG. 2** in that the rigid spacer element is a tongue **29** that extends at a right angle from the frame section **28** and separates the transparent plates. The spacing element **29** is either an integral part of, or is fastened to, the frame section **28** by the fastening means **10**. A desiccating strip **27** is positioned on the tongue surface **40** which faces the interior of the unit between the transparent plates **5** and runs around the inside circumference of the sealed unit. This strip preferably has low moisture vapor permeability. If the strip **27** is a desiccating strip and the external moisture barrier **4** is efficient in preventing moisture ingress into the unit, then the desiccating strip **27** is not required to run around the full inside circumference of the unit.

The embodiment of the invention in **FIG. 6** is similar to that shown in **FIG. 2**, except that the spacer **104** is provided with at least one elongate groove **105** that runs along at least one side of the lateral walls of said spacer. Said grooves hold the desiccant **100** comprising a compressible formulation of low adhesion to facilitate the removal of the transparent plate. Said desiccant is in gaseous contact with the interior of the sealed unit through the gap **102** located between the spacer **104** and the inside of the transparent plate. A further advantage of this embodiment is that the desiccating strip is not required to be continuous

around the periphery of the transparent plate. The edge and outer circumference of the second transparent plate **1005** is provided with the moisture seal **1044** .

The embodiment shown in **FIG. 7** is similar to that in **FIG. 3** except that it provides a sealable tubular opening **202** through the frame **201** into the unit. The frame **201** is provided with two parallel vertically extending elongated legs **14**, directed towards the inside of the unit and spaced apart by a gap **210**, said gap extending towards the desiccant **217** in an elongate cavity **204** within the frame section **201**. In one of my embodiments, said gap **210** is sufficiently wide to hold a third transparent plate parallel to the two outer plates.

From the cavity **204**, a tubular opening **202** leads through that frame section **201** terminating preferably adjacent to the glazing stop **3**, where that tubular opening is closed by sealing means such as a hermetically sealed but extractable sealing plug **218**. Alternatively, the direction of said tubular cavity through the frame is parallel to the direction of the plates and the opening of said tubular cavity is located on the outmost periphery of the sealed unit.

The frame portion **201** is provided with grooves **206** adjacent and parallel to the legs **14** essentially opposite to and around the edge of the transparent plates. These grooves are filled with a mastic moisture vapor seal of low viscosity. The periphery of each transparent plate is surrounded by a sealant strip **208**, and the plates are supported as described before. Through the cavity **202** the pressure inside the unit can be reduced or increased and the desiccant can be replaced. The vent is sealed by any of several conventional methods as known in the art, such as a plug **218** or by the crimping of an inserted metal tubing.

A further embodiment of my invention is shown in **FIG. 8**, which is similar to **FIG. 6** except that the frame section **61** is provided with an elongate groove **60**, defined by the vertical walls **250** and **254** and by the horizontal wall **252**. Into this groove is inserted the desiccant formulation **66** to which are attached, either adhesively or non-adhesively, the transparent plates along their interior circumferences. The strip **66** is made sufficiently rigid to provide effective spacing of the transparent plates. The position of the transparent plates

relative to each other is determined by the limited compressibility of the desiccant strip **66** positioned in the groove **60.** A limit to the compressibility of said strip is achieved by selecting a partially compressible material or by the inclusion into that sealant strip of a non-compressible shim vertically oriented with respect to the transparent plates. An external moisture seal is provided by the sealant **4** around the edge of the transparent plate and the glazing stop **3** on the outside of the unit. If the external moisture seal **4** is fully effective, it is not essential that the desiccant strip **66** be continuous. The frame section **61** may comprise more than one matching elongate sections, as described in a later embodiment of this disclosure.

The embodiment shown in **FIG. 9** is a detachable frame and spacer assembly for three transparent plates, comprising a frame section **500** provided with two vertical parallel elongate legs **516**, directed towards the inside of the unit to space apart the two outer transparent plates. These legs form the cavity **510** defined by the walls **518, 520** and **522.** This cavity holds the desiccant material **570** and a third transparent plate. The desiccating material is preferentially the center portion **570** of a sealant strip. That sealant strip further comprises on each of its sides the moisture sealing outer widths **560** and extends with these moisture sealing widths over the legs **516** towards the outer transparent plates, whereby the moisture sealing section **560** of that strip surrounds the edges and outer periphery of these transparent plates.

The frame and spacer element preferably comprises two matching segments with tongue and groove interlocking interfaces **524** extending from the cavity **510** across the frame section **500** to the exterior of the sealed unit. The fastening means **9** such as screws, clips or screws, hold together the glazing stop **3** and the frame member **500**, and attach the window and frame unit to an outer frame **114.** The outer frame **114** is constructed of any suitable building material that can hold a window in a structural opening.

A further embodiment of my invention is shown in **FIG. 10** where the spacer frame **812** comprises a center section **814** which spaces apart two transparent plates, first legs **815** at right angle to **814**, projecting outwardly beyond the edges of the transparent plates,

and second legs **816**, at right angle to **815**, projecting beyond the glass edge. Said legs form the external groove **810**. The frame can be fastened as shown in **FIG. 2**. The pocket **810** can be filled with sealant material or rigid foam to stiffen the structure and to hold the unit in an external frame. The sealant and desiccating functions for the sealed unit are provided by any of the means discussed before, as for example described for **FIG. 2**. The transparent plates are attached and supported by any of the suitable methods discussed before.

A further embodiment of my invention is shown in **FIG. 11** in which detachable frame members are joined together to compress a sealant strip. The frame comprises first and second parallel matching elongate members **700** and **702** with parallel legs **712** and **714** on opposing sides and directed towards the inside of the unit, and a third elongate member **720** which projects beyond the outer edges of the members **700** and **702** . A tongue **715** essentially at the center of **720** projects towards the inside of the unit and spaces apart sections **700** and **702**. The parallel legs **712** and **714** are spaced apart by a seal which comprises first a desiccant portion **707** on that side which faces the cavity **8** between the transparent plates, and second a moisture vapor seal portion **709**, that faces the rib **715** and the outside of the unit. The seal can comprise a single formulation that is desiccating and moisture vapor sealing. To increase the resistance to moisture penetration into the sealed unit, a moisture barrier film is located between the desiccating and the moisture sealing portion, as described in later embodiments of my disclosure. The width of the seals **707** and **709** is larger than the width of the rib **715**. The unit can be disassembled and the seal be replaced. The frame sections **700** and **702** are mechanically locked together and tied to the rib **715** from at least one side of the frame by fastening means **730** such as bolts, which pass through two of these three elements. The transparent plates are spaced apart by the legs **712** and **714**, each of the outer edges **722** and **724** of said legs being covered by a moisture seal **4**. The tightening of the frame members by the fastening means **730** seals the unit, whereby the limit to this compression is set by the width of the rib **715**. The transparent plates are held by external stops. My sealed system is different from the design

by Stroud, U. S. Patent 2,169,713, by employing the advantage of threaded fasteners to attach such frame members, which permits the use of frame members which are simple in their construction and therefore less expensive to manufacture. Furthermore, Stroud teaches the use of a rubber sealing means in order to provide the necessary flexibility in the frame to permit this frame construction to be used. My construction does not have this disadvantage.

The embodiment shown in **FIG. 12** allows the removal of the sealed window towards one side, preferentially to the interior of the building. The spacer profile is comprised of an elongate section **641** that projects perpendicularly to the plates at least to the outer edges of these plates, and from which on the side opposite to the plates a leg **645**, with parallel sides **652** and **654** and an outer side **656**, extends perpendicularly. On the opposite side of **641**, two legs **649** project perpendicularly, which are provided with tabs **622** in an opposing direction relative to each other to create a pocket that holds the desiccant **707**. The legs **649** space apart the transparent plates. The moisture barrier sealant **4** bonds the inner circumference of the transparent plates **5** to the legs **649**, and bonds the edges of the transparent plates to the section **641**, and bonds the outer circumference of the plates to the pressure plate **3**. The rib extension **645** is placed into an L-shaped frame sections **660** in such a way that one of the parallel sides of **645** faces the inner short side of the L-shaped section **660**, and the longer inner side of the L-shaped section **660** faces the outer side of the leg **645**, thus creating a cavity surrounded by **641**, **645** and **660**, into which is inserted the elongate detachable second frame section **670** in such a way that the second parallel side of the leg **645** is in contact with section **670**. Threaded fasteners, pins or other suitable fastening means **699** will hold the glazing stop **3**, the frame section **641**, and the two matching frame members **660** and **670** together. The sealed unit can be removed by removing the fastening means **699** and the frame element **670**.

The embodiment shown in **FIG. 13** shows the same principle as **FIG. 12** except for the modification that the glazing stop **693** and the adjacent frame member, **690**, comprise one integral part oriented at a right angle with respect to each other and of which the base

section **690** faces on its short side the rib **675** of the spacer element, and the wider side of that base section faces the outmost element **680** of the frame. **FIG. 13** is further similar to **FIG. 12** except that the gap **697**, that connects the cavity that holds the desiccant with the cavity between the transparent plates, is sufficiently wide to surround the periphery of a transparent plate, thus providing a unit comprising three transparent plates. My system is a significant improvement over the known art of sealed windows, in that the gaps introduced in my design, formed between the inner end of the tabs and the central plate, allow the gaseous material between the plates to be in contact with the desiccant material. Furthermore, the sealed system taught by Francis, Canad. Pat. 1,265,705, does not comprise a spacing member having two parallel legs that project inwardly along the interior surfaces of the outer plates.

A further embodiment of my invention is illustrated in **FIG. 14** which shows the frame section **177** with two T-shaped parallel extensions **174** vertically and integrally connected to **177**. These extensions space apart three transparent plates. The opposing inwardly directed legs **160** of these extensions provide a cavity for the desiccant **117**, and also frictionally hold the central transparent plate **55**. The outwardly directed leg **165** of each of the extensions **174** is opposite to the inner periphery of an outer transparent plate **5**. The gaps **166** between the central transparent plate and the legs **160** permit the desiccation of the cavities between the transparent plates. The moisture barrier seal **4** extends from the cavity **164**, formed by the outer transparent plate **5** and the extension **174**, to the outer periphery of that plate and below the glazing stop **3** which holds the glass in the frame.

The embodiment in **FIG. 15** is similar to that in **FIG. 14** except that the frame comprises two matching and interlocking frame members **176** and **178**. These frame member meet along an interface in a plane that is generally parallel to the transparent plates and extends through the cavity **170**. The frame members are connected and sealed by opposing overlapping elongate tongues **182** and **186**, and further by a sealant **180** between at least partially across these interlocking interfaces. The desiccant is centrally located within the frame with respect to the periphery of the transparent plates and can be replaced

by separating the frame members.

A further embodiment of my invention in **FIG. 16** comprises a self-adhesive desiccating and moisture vapor sealing strip comprising an elongate sealing member of generally uniform width. The member is divided into first and second longitudinally extending, adjacent sections with the first section **902** comprising the moisture sealant, and the second section **905** comprising the desiccant. The self-adhesive property is provided by formulations based on tacky acrylic polymers or by formulations based on polyisobutylene, and the moisture sealing property is provided by polyisobutylene formulations. The separation of the moisture sealing portion and of the desiccating portion of the strip and their placement in the critical sections of the sealed unit increases the effectiveness of these functions. The acrylic formulation improves the stability of the bond of the strip to the transparent plate under mechanical stress and during the exposure to degrading environmental influences such as exposure to solar radiation.

Several configurations of the sealant strip are effective. In **FIG. 17** the strip is comprised of a center desiccating width **904** and two moisture sealing outer widths **902**. **FIG. 18** shows a strip of which the moisture sealing section **906** is the center width, and the desiccating sections **908** are the outer widths. In **FIG. 19** the moisture sealing portion **906** is partially extended by sections **910** over the adjacent outer desiccating portions **908** so that the outer desiccating sections **908** are surrounded on two sides with that moisture seal. In **FIG. 20** the outer widths **902** of the moisture seal sections of the strip shown in **FIG. 17** is extended over the center desiccating section **904** with the moisture sealing layer **912**, in such away that the desiccating width **904** is surrounded by the moisture sealing formulation on three of its four sides. In **FIG. 21** the moisture sealing section **902** of the dual strip shown in **FIG. 16** is extended over one side of the desiccating width **905** by the moisture sealing layer **910**. The thickness of such dual strips may not be uniform across its width in order to reduce the effect of stretching during the application of the strip around the circumference of the transparent material or over an edge of the spacer frame. To set a limit the compression of the strip under pressure, the desiccant in the strip may comprise

granules of a diameter as high as the thickness of the strip. The moisture sealing width of the strip may be of a larger height in a cross-sectional view than the desiccant portion in order to provide a better moisture sealing of the strip under the compression of the strip between two interfaces.

The embodiment in **FIG. 22** is similar to that of the sealant strip in **FIG. 16** except that between the interfaces of the desiccating portion **905** and the moisture sealing portion **902** of said strip is located a bendable strip **920** of essentially narrower width and thickness than the portions **902** and **905**, said strip comprising a thermoplastic, plastic or metallic material to essentially eliminate the moisture transmission across the interface between said desiccating and the vapor sealing portion.

A further embodiment of my invention is shown in **FIG. 23** in which adjacent and opposing plates of a set of at least three transparent plates **5** are spaced apart at their periphery by a self-adhesive sealant strip, said strip comprising a first and desiccating portion **905**, a second and moisture vapor sealing portion **902**, and as third portion a bendable moisture barrier **920** located between said first and second portions of said strip, as shown in **FIG. 22.** The desiccating portion of said strip faces the cavity **8** between the transparent plates, and is generally narrower with respect to its longer cross-section dimension than the moisture sealing section, and is preferably comprised of a desiccating agent dispersed in a tacky acrylic polymer or in a polyisobutylene formulation The vapor sealing portion **902** preferably comprises a polyisobutylene formulation. The narrower desiccating section is preferentially formulated to have a higher compression resistance than the wider moisture vapor sealing section **902** to provide the strip with desirable combination of vapor sealing efficiency and compression resistance.

A further embodiment of my invention is shown in **FIG. 24** which illustrates the application of the dual sealant strip in the configuration of a sealed unit comprised of three transparent plates. In this embodiment, the edge and peripherics of the center transparent plate **550** are inserted into an elongate pocket **412** of a tubular frame, which is formed by a base member **424** which is at a right angle to the plate, and two parallel legs **420**, vertical

to **424** and directed towards the inside of the unit. At the end of each of these legs is a tab **422** positioned so that the tabs of the adjacent legs are opposing each other and enclose the periphery of the transparent plate to provide a friction fit and to leave a gap **426** sufficient for the desiccant **407** in the cavity **412** to remove moisture from the air spaces between the transparent plates. The desiccant is a powder, or a compounded gunnable material, or is preformed to fit into the cavity **412** . The outer sides of the vertical legs **420** and the inner surface of the outer transparent plates are bonded by a sealant strip, comprising the desiccating section **908** and the moisture sealing section **906** in such a way that at least part of the space between the legs **420** and the external plates is bonded by the desiccating section of the strip, and at least the outer side of the base element **424** is covered with the moisture sealing portion of the strip. The strength of the sealed unit can be further improved by bonding the outer plates by a structural sealant **400** located in the cavity created by the inside periphery of the external plates and the outside of the element **424**. If that structural sealant is a moisture barrier, the moisture sealing section **906** can be replaced by such a sealant.

FIG. 25 shows how the open-figure elongate channel of **FIG. 24** is preferably assembled from two matching elongate channel members **450** and **460,** that extend alongside each other and are detachable and rigidly connected to each other by the tongues **452, 454,** and **462**.

Several modifications to the described embodiments will become apparent to those skilled in this art after considering this disclosure and the drawings. All such modifications and changes as fall within the scope of the appended claims are intended to form part of the present invention.

The embodiment of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A transparent insulating unit suitable for a building exterior comprising two spaced-apart, transparent, parallel plates having two exterior surfaces, rigid spacer means arranged between said plates and extending along the periphery of said plates, elongate supporting frame means extending along edges of said plates and also extending in a transverse direction perpendicular to the major surfaces of said plates outwardly beyond both of said exterior surfaces, said spacer means being rigidly and directly connected to said frame means, elongate rigid stop means extending along the periphery of said plates adjacent said exterior surfaces and holding said plates in said frame means, the stop means adjacent at least one of said two plates being detachably connected to said frame means by threaded fasteners, means for sealing said unit along the edges of said plates so as to prevent moisture from entering a space between said plates; and means for removing moisture from said space between said plates, wherein one of the said plates can be readily removed from said frame means without removing the other of said plates by removing said threaded fasteners and detaching the respective stop means from said frame means.

2. A sealed unit according to claim 1 wherein said moisture removing means is a desiccating material arranged along said edges of said plates and in contact with the gaseous material located in said space between said plates.

3. A sealed unit according to claim 1 wherein the detachable stop means adjacent at least one of said two plates comprises several stop members each extending substantially the length of adjacent edges of said plates.

4. A sealed unit according to claim 1, 2 or 3 wherein said frame means has a inside surface facing said plates and said inside surface has two substantially flat areas extending outwardly from said spacer means to two opposite edges of said frame means, said stop means adjacent both of said two plates being detachably connected to said flat areas of said frame means.

5. A sealed unit according o claim 1, 2, or 3 wherein said rigid spacer means is detachably connected to said frame means.

6. A sealed unit according to claim 1,2, or 3 wherein said stop means acts to press said two plates toward said spacer means, and thereby help to seal said unit along the edges of said two plates.

7. A transparent insulating sealed unit suitable for a building exterior comprising at least two spaced-apart transparent, parallel plates having two exterior surfaces; elongate supporting frame means extending along edges of said plates and also extending in a transverse direction perpendicular to the major surfaces of said plates and outwardly beyond both of said exterior surfaces, said frame means including first and second elongate frame members that extend alongside each other and are detachably and rigidly connected to each other by two or more threaded fasteners; rigid spacer means provided on at least one of said frame members and arranged between said at least two plates along the edges thereof; elongate rigid stop means provided on each of frame members and extending along the periphery of said plates adjacent said exterior surfaces, said stop means holding said plates in said frame means, means for sealing said unit along the edges of said plates so as to prevent moisture from entering a space between said plates, and means for removing moisture from said space between said plates, wherein one of said plates can be readily removed from one of said frame members and the other plate or plates without removing the other plate or plates from one frame member by removing said threaded fasteners and detaching the other frame member from said one frame member.

8. A sealed unit according to claim 7 wherein both frame members are formed with longitudinally extending tongues that overlap and contact each other when the frame members are connected together, said tongues acting to keep said frame members properly aligned along their lengths.

9. A sealed unit according to claim 7 wherein said moisture removing means is a desiccating strip extending along at least one of said frame members, strip being in gaseous contact with air in said space between said plates.

10. A sealed unit according to any one of claims 7 to 9 wherein each stop means comprises an integral extension of its respective frame member and said sealing means comprises vapor barrier strips arranged between each stop means and the exterior surface of an adjacent one of said plates.

11. A sealed unit according to claim 9 wherein said desiccating strip is located in a cavity formed between said first and second frame members, said cavity being partially covered on a side thereof located next to said space between the plates by at least one of the frame members.

12. A sealed unit according to claim 1, 3 or 7 wherein said frame means is made of wood or plastic material.

13. A sealed unit according to any of the claims 7 to 9 wherein said first and second frame members meet along a matching interface that extends generally in a plane that is parallel to said exterior surfaces and between said exterior surfaces.

14. A sealed unit according to any of the claims 7 to 9 wherein said first and second frame members meet along a matching interface that extends generally in a plane that is parallel to said exterior surfaces and between two of said plates.

15. A sealed unit according to claim 9 having three spaced-apart transparent, parallel plates, wherein said spacer means is split longitudinally into two separate spacers separated by a central slot, a central one of said plates having a peripheral edge that extends into said central slot and wherein said desiccating strip is located in an elongate cavity formed between said frame members and defined at least partially by said spacer means.

16. A transparent insulating sealed unit suitable for a building exterior comprising at least two spaced-apart, transparent parallel plates arranged side-by-side with the two outer plates having interior surfaces, edge forming means extending along the periphery of said plates and in a transverse direction over edges of both said outer plates, said edge forming means including two, spaced-apart inner flanges extending along the periphery of said plates and projecting inwardly along said interior surfaces of the outer plates so that said flanges act as spacers for the plates, and also including an elongate rib section

projecting outwardly in a direction away from said plates and adapted for connection of the sealed unit to a window frame, desiccant material contained within said edge forming means, means for sealing said unit along the edges of said two outer plates, and exterior stop members for holding said two outer plates in place in said edge forming means, wherein said edge forming means is not connected directly to at least one of said outer plates.

17. A sealed unit according o claim 16 wherein said edge forming means is not connected directly to either of said exterior plates.

18. A sealed unit according to claim 16 wherein said desiccant material is located in a pocket formed in said rib section and said pocket is open to an air space or air spaces formed between said outer plates.

19. A sealed unit according to any of the claims 16 to 18 wherein said exterior stop members are detachably connected to said edge forming means which has outer edge sections located outwardly beyond exterior surfaces of said two outer plates.

20. A sealed unit according to claim 16 or 17 wherein said desiccant material is contained within a pocket formed between said inner flanges and said pocket is open to an air space formed between said outer plates.

21. A transparent , triple glazed unit suitable for a building exterior comprising three spaced-apart transparent, parallel plates arranged side-by-side with the two outer plates having interior surfaces, elongate spacing members extending along edges of said plates, each spacing member including a base section substantially extending from one of the outer plates to the other of the outer plates and passed an adjacent edge of the central plate and further including parallel legs extending along the periphery of the outer plates and projecting inwardly along the interior surfaces of the outer plates, tabs extending inwardly from said legs towards the central plates and acting to hold said central plates in a central position between free inner ends of said tabs, means sealing said unit extending along the edges of said outer plates; and desiccant material extending along said spacing m embers and located therein, wherein gaps are formed between said free inner ends of said

tabs and said central plate so that air in two air spaces located between said outer plates is in gaseous contact with said desiccant material.

22. A triple glazed sealed unit according to claim 21 wherein said sealing means extends over an outer surface of the base section of each spacing member.

23. A triple glazed sealed unit according to claim 21 wherein said base section extends beyond exterior surfaces of the two outer plates and elongate, rigid stop means extend along the periphery of the outer plates and are connected to said base section, said stop members acting to hold said outer plates in position relative to he base section.

24. A triple glazed sealed unit according to claim 23 wherein said stop means are formed integrally on said base section and have inwardly projecting tabs formed thereon, each extending towards the adjacent outer plate, said sealing means including a vapor seal positioned between each stop means and the adjacent outer plates.

25. A triple glazed sealed unit according to claim 23 wherein said stop means are detachably connected to said base section by means of threaded fasteners and said sealing means is located a least between an edge section of each outer plate and the stop means adjacent thereto.

26. A spacer for holding apart at least two transparent plates of a sealed window wherein first and second spacer members meet along a matching interface that is generally in a plane that is parallel to said plates.

27. A desiccating and moisture vapor sealing strip for use in a sealed glazing unit, said strip comprising an elongate sealing member of generally uniform width, said sealing member being divided into at least first and second longitudinally extending, adjacent sections, said first section comprising a desiccating material and said second section comprising a moisture vapor sealing material having a low moisture transmission rate, wherein at least said vapor sealing material is a self-adhesive material.

28. A sealing strip according claim 26 wherein said first section has first and second major, parallel surfaces, one of which is uncovered and the other of which is covered with a layer of moisture vapor sealing material.

29. A sealing strip according to claim 26 including a third, longitudinally extending section comprising a desiccating material, wherein said first and third sections extend along opposite side edges of said second section.

30. A sealing strip according to claim 26 or 28 wherein said first and second sections are separated only by a thin moisture barrier film extending between upper and lower surfaces of the strip.

31. A sealing strip according to any of the claims 26 to 28 wherein said desiccating material is produced from acrylic polymer.

Fig. 1 2164346

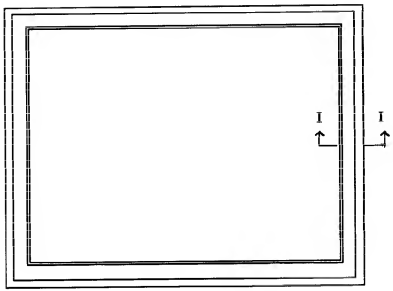
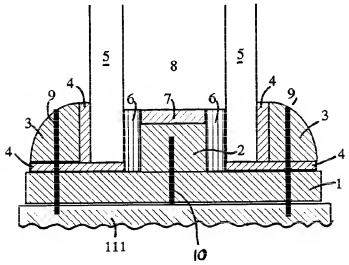


FIG. 2



Lautenschlaeger

Fig. 1, 2

FIG. 3

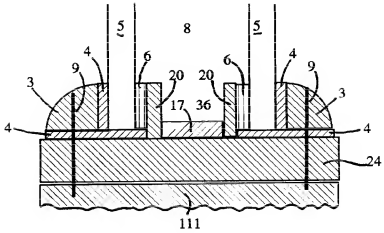
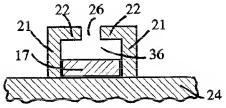


Fig.4



Lautenschlager

Fig. 3,4

Fig. 5

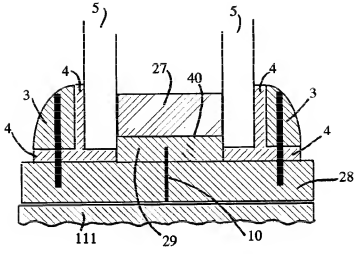


FIG. 6

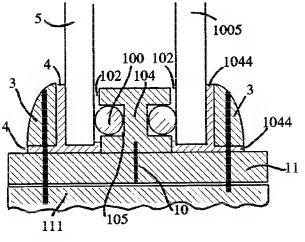


Fig. 5,6

Lautenschlager

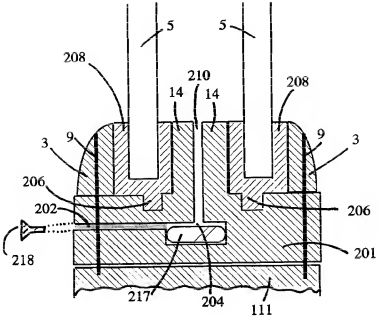


Fig. 7

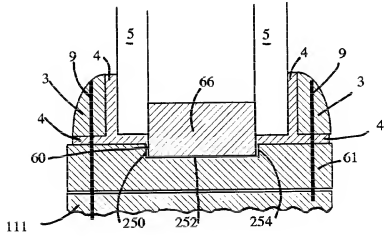


Fig. 8

Fig. 7,8

Lautenschlager

Fig. 9

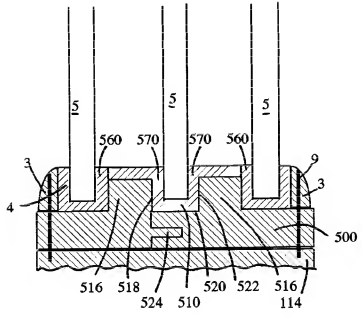


Fig. 10

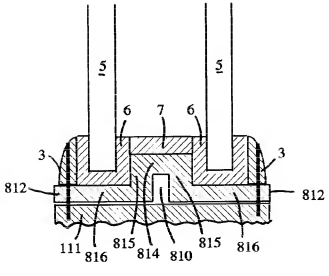


Fig. 9,10

Unterschlager

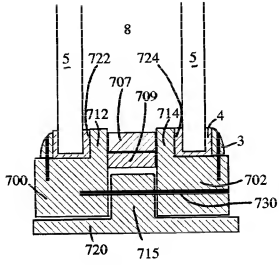


Fig. 11

Lautenschlager

Fig. 12

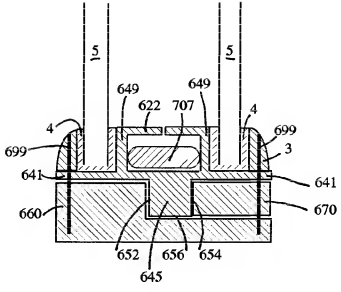


Fig. 13

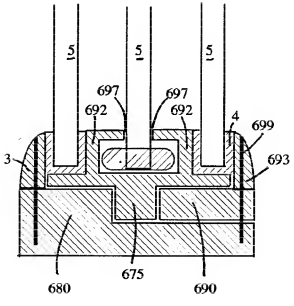


Fig. 12, 13

Lautenschlager

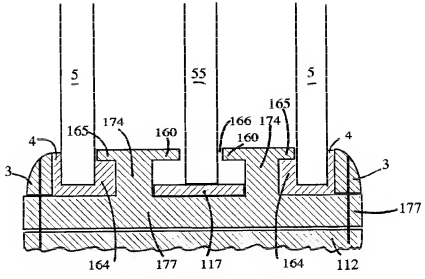


Fig. 14

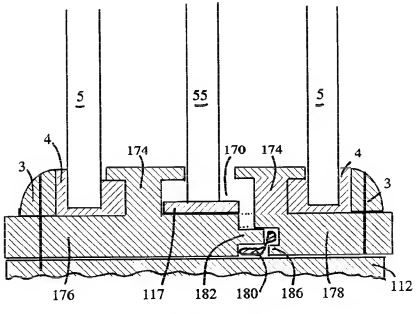


Fig. 15

Fig. 14, 15

Lautenschlager

Fig. 16

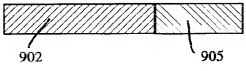


Fig. 17

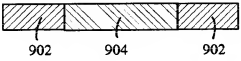


Fig. 18

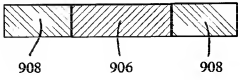


Fig. 19

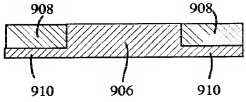


Fig. 20

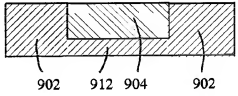


Fig. 21

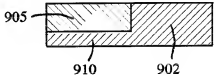


Fig. 22

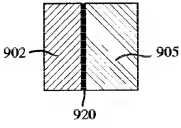


Fig. 16-22

Lautenschlager

Fig. 23

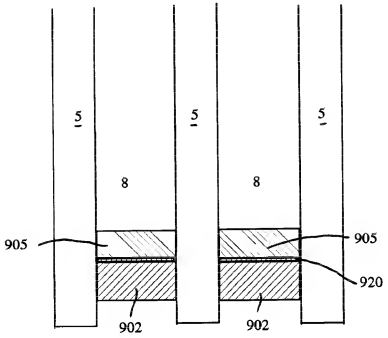


Fig. 23

Lautenschlager

Fig. 24

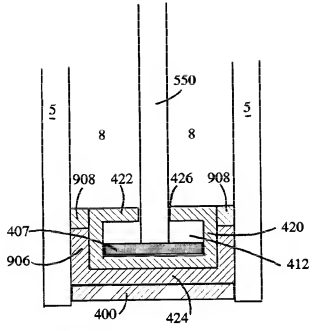


Fig. 25

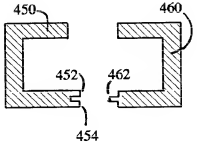


Fig. 24, 25

Lautenschlager